

CLAIMS

1. A method of controlling the rate of data transmission from a source of data to a user via a communications link, wherein processing means are provided to generate
5 a signal representing a rate request which will be used in determining the rate at which data will be transmitted from the source to the user, said processing means generating the signal by carrying out the steps of:
obtaining an indication of the amount of congestion on said communications link,
10 selecting a value indicative of the user's willingness to pay for a given transmission data rate, and
determining the rate to be requested as a function of the indication of the amount of congestion and the user's willingness to pay weighted by a variable parameter, the
15 processing means thereafter communicating the signal to the source of data and the rate of the data transmission from the data source to the user then being controlled on the basis of the signal.
2. A method according to claim 1, wherein said variable parameter assumes
20 discrete values.
3. A method according to claim 1, wherein the value of said variable parameter varies continuously.
- 25 4. A method according to claim 1, wherein the indication of congestion is the product of a congestion charge and a previously determined data transmission rate.
5. A method according to any of the preceding claims, wherein the value of said variable parameter varies in accordance with the difference between the user's
30 willingness to pay and the indication of the amount of congestion.

6. A method according to any preceding claim, wherein said rate to be requested is determined using the following iterative equation:

$$x_{n+1} = x_n + \text{delta} * \text{kappa} * x_n^{\xi} (w - x_n * \mu)$$

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where x_n is the data transmission rate (bits per second) as calculated at an n th iteration; and x_{n+1} is the rate to be determined; $x_n * \mu$ is the charge to the user indicative of amount of congestion and is the product of x_n and congestion charge μ ; w is the willingness to pay ; delta is the time elapsed between two iterations; kappa is a
10 constant gain parameter; and ξ (ξ) is a parameter whose value is set depending on the indication of congestion or the user's willingness to pay.

7. A method according to claim 5, wherein if the difference between the indication of the amount of congestion and the user's willingness to pay falls within a
15 predetermined range a first data rate is requested, and if the difference between the indication of the amount of congestion and the user's willingness to pay falls outside the predetermined range a second different data rate is requested.

8. A method according to claim 7 wherein said parameter ξ is a step function
20 assuming the value 0 for values of said difference larger than a threshold value, and assuming the value 1 for values of said difference smaller than said threshold value.

9. A method according to claim 7 said step of providing an indication of amount of congestion includes determining a marking rate m of incoming data transmitted on
25 said communications link and wherein said congestion charge is determined from said marking rate.

10. A rate controller for controlling the rate of data transmission from a source to a user via a communications link, said rate controller including processing means for
30 generating a signal representing a rate request which will be used in determining the rate at which data will be transmitted from the source to the user, said processing means including

means for obtaining an indication of the amount of congestion on said communications link,

selecting means for selecting a value indicative of the user's willingness to pay for a given transmission data rate,

- 5 determining means for determining the rate to be requested as a function of the indication of the amount of congestion and the user's willingness to pay weighted by a variable parameter, the processing means further including means for communicating the signal to the source, wherein the rate of the data transmission from the source to the user is controlled on the basis of the signal.

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11. A rate controller according to claim 10, wherein said determining means is adapted to, determine the difference between the user's willingness to pay and the indication of the amount of congestion, and vary the value of the variable parameter in accordance with the difference.

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12. A rate controller according to claim 11, wherein said determining means determines a first rate to be requested if said difference between the indication of the amount of congestion and said selected value falls within a predetermined range, and a second different data rate to be requested if the difference between the indication of the amount of congestion and the value falls outside the predetermined range.
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13. A rate controller according to any of preceding claims 10-12, wherein said determining means is adapted to determine said rate to be requested using the following iterative equation:

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$$x_{n+1} = x_n + \text{delta} * \text{kappa} * x_n^{\xi} (w - x_n * \mu)$$

- where x_n is the data transmission rate (bits per second) as calculated at an nth iteration and x_{n+1} is the rate to be determined; $x_n * \mu$ is the charge to the user indicative of amount of congestion and is the product of x_n and congestion charge μ ; w is the willingness to pay selected by selecting means in response to a determined transmission rate; delta is the time elapsed between two iterations; kappa is a constant gain parameter; and ξ
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(xi) is a parameter whose value is set depending on the indication of congestion or the user's willingness to pay.

14. A rate controller according to any of preceding claims 10-13, wherein said
5 means for obtaining an indication of the amount of congestion comprises metering means for determining a marking rate of incoming data transmitted on said communications link.

15. A rate controller according to any of preceding claims 11-14, wherein said
10 variable parameter is a step function assuming the value 0 for values of said difference larger than a threshold value, and assuming the value 1 for values of said difference smaller than said threshold value.

16. A method of controlling the rate of data transmission from a source of data to
15 a user via a communications link, wherein processing means are provided to generate a signal representing a rate request which will be used in determining the rate at which data will be transmitted from the source to the user, said processing means generating the signal by carrying out the steps of:
obtaining an indication of the amount of congestion on said communications link,
20 selecting a value indicative of the user's willingness to pay for a given transmission data rate,
determining the rate to be requested on the basis of the ratio of said value to said indication of the amount of congestion on said communications link.

25 17. A method of controlling the rate of data transmission according to claim 16 wherein said rate to be requested is determined using the following equation:

$$x_{n+1} = x_n + \delta^* \kappa^* \left(\frac{w}{\mu} - x_n \right)$$

30 where x_n is the data transmission rate (bits per second) as calculated at an nth iteration and x_{n+1} is the rate to be determined; μ is the congestion charge indicative of amount of

congestion; w is the willingness to pay; δ is the time elapsed between two iterations; and κ is a constant gain parameter.

18. A rate controller for controlling the rate of data transmission from a source to a user via a communications link, said rate controller including processing means for generating a signal representing a rate request which will be used in determining the rate at which data will be transmitted from the source to the user, said processing means including means for obtaining an indication of the amount of congestion on said communications link,
- selecting means for selecting a value indicative of the user's willingness to pay for a given transmission data rate,
- determining means for determining the rate to be requested as on the basis of the ratio of the user's willingness to pay to said indication of the amount of congestion on said communications link, the processing means further including means for communicating the signal to the source, wherein the rate of the data transmission from the source to the user is controlled on the basis of the signal.

19. A rate controller according to claim 18 wherein said determining means is adapted to determine said transmission data rate using the following equation:

$$x_{n+1} = x_n + \delta * \kappa * \left(\frac{w}{\mu} - x_n \right)$$

- where x_n is the data transmission rate (bits per second) as calculated at an n th iteration and x_{n+1} is the rate to be determined; μ is the congestion charge indicative of amount of congestion; w is the willingness to pay; δ is the time elapsed between two iterations; and κ is a constant gain parameter.

20. A program storage device readable by a processing apparatus, said device embodying a program of instructions executable by the processor to perform the steps of any one of the method claims 1 to 9 or 16 to 17.